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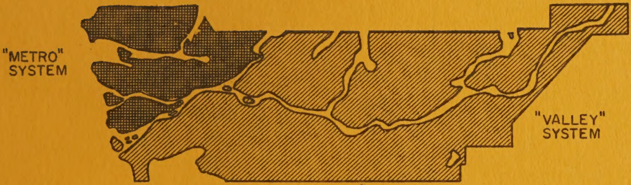
CO-ORDINATE SYSTEMS
FOR THE LOWER MAINLAND



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V. J. PARKER, EXECUTIVE DIRECTOR

LMRPB

LOWER MAINLAND REGIONAL PLANNING BOARD

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OUR FILE:

March 31, 1969

LMRPB Executive Committee,
Member Municipal Councils,
Municipal Officials.

Ladies and Gentlemen:

re: Regional Co-ordinate Systems

Since 1966 the LMRPB has been working on the formulation and establishment of a common urban information system for the Lower Mainland for use by Municipal, Provincial and Federal government agencies, research institutions, and private enterprise. Most of the work to date has focussed on establishing Regional Co-ordinate Systems for the efficient storage and retrieval of information. Two draft reports and an Interim Report have been written, each in turn stimulating further discussion towards selecting the best possible method of referencing urban information in the Lower Mainland. The Interim Report of December, 1967 was followed by a major meeting in our offices in May, 1968 of Federal, Provincial, and Municipal representatives. As a result of this and other meetings, earlier Board proposals for co-ordinate referencing were subsequently reconsidered.

This final report draws on previous reports and an ongoing dialogue between Board staff and government officials. In particular it recommends that the Dominion Bureau of Statistics Geographically Referenced Data Storage and Retrieval System (GRDSR) be adopted for Greater Vancouver (except Surrey, Delta and White Rock), and that the LMRPB address-based Valley Co-ordinate System be implemented south of the South Arm of the Fraser River and east of the Pitt River. The details of implementing the Valley Co-ordinate System have been spelled out in the report The Valley Co-ordinate and House Numbering Systems, while specific procedures for the GRDSR System are likely to be available from Ottawa in the near future.

It is hoped that this work of your Regional Staff will lead to further consideration and implementation of these co-ordinate referencing systems.

Respectfully submitted,

N. Pearson.

N. Pearson
Assistant Director
(Regional Studies)

V.J. Parker

V.J. Parker,
Executive Director

ACKNOWLEDGEMENTS

The preparation of this final report has largely rested on the shoulders of Mr. E. Karlsen who has carefully worked out the complexities of the "Metro" System in the perspective of the Valley Co-ordinate System. Work on the latter, and much of the initial thought behind the use of co-ordinate systems in the Lower Mainland was the work of Mr. G.V. Stallard, now with the District of Saanich Planning Department, and myself. The detailed aspects of the Valley Co-ordinate System have been the work of Mr. B. Olson.

Acknowledgement is gratefully given for the invaluable assistance of the many persons and agencies that have contributed to this and earlier reports. In particular, I would like to thank:

- Mr. J.I. Weldon and Mr. J.S. Lefebvre of the Dominion Bureau of Statistics, who introduced the LMRPB staff and others to the GRDSR System.
- The LMRPB Technical Committee, comprised of the Lower Mainland Municipal Planners.
- Mr. W. Curtis, Mr. K. Dobell, Mr. G. Farry, and Mr. R.L. Hawkins, of the City of Vancouver.
- Dr. H. Dempster and Dr. G. Schrack, of the University of B.C.
- Mr. W. Ellsay, Data Processing Centre, Department of Industrial Development, Trade and Commerce, Parliament Buildings, Victoria.
- Mr. W.R. Young, Surveys and Mapping Branch, Department of Lands, Forests and Water Resources, Parliament Buildings, Victoria.
- Mr. R.R. Sampson, Assessment Commissioner's Office, Parliament Buildings, Victoria.

Norman Pearson
Assistant Director (Regional Studies)

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1969 LMRPB EXECUTIVE COMMITTEE

With the transfer of the regional planning function from the LMRPB to the four Lower Mainland Regional Districts (Greater Vancouver, Dewdney-Alouette, Central Fraser Valley, and Fraser-Cheam) on March 31, 1969, the affairs of the LMRPB from January 1 to March 31 were placed in the hands of the Executive Committee: D.A.S. Lanskail, Chairman; H.G. Hunt, Vice-Chairman; N.W.E. Cox; J. Francis; G.H.F. McLean; R.A. McMath; S.C. Maplethorp, D.W. Poppy; E.C. Sweeney; D.G. Taylor.

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INTRODUCTION

In recent years our way of life, our communities, and our governments have become increasingly complex and sophisticated, and to an unprecedented degree major management decisions are being framed within knowledge provided by comprehensive up-to-date information. The resulting problems of information collection, recording, storage, retrieval, and use have been experienced by almost every organization, public and private. Meeting these increasing informational demands adequately and efficiently will necessitate increasing reliance on information systems and computers. While the total problem is much greater, this report concentrates on the biggest component of the information problem, that of developing a co-ordinate system for collecting, labelling, and filing information.

In Municipal goverment every employee creates, handles, and uses information in the course of his daily work. Assessment records, building permits, plumbing inspections, statistics, voter lists, tax notices, water line extension plans--the list is endless. In some smaller municipalities the Municipal Clerk is able to perform all information handling tasks, with everything at his fingertips. But in the larger municipalities, and probably in all municipalities in due course, the growing mountain of information requires more sophisticated methods of information handling. With the rapid growth and increasing complexity of our urban areas, the quality and objectivity of Municipal decisions ultimately depends upon the availability and accessibility of accurate and complete up-to-date information.

The potential of the computer and related automated data processing equipment to provide quick factual information for reliable analyses required in management level decision-making is becoming increasingly apparent in most governmental operations. Presently some 10 of the 14 Greater Vancouver municipalities use electronic data processing services--by and large to streamline paperwork and record-keeping for tax billing, utilities billing, the printing of payrolls, and bookkeeping. Only in a few municipalities has attention been directed to preparing master property rolls for assessment work, commercial licence administration, utilities planning, or land use inventories, and only in still fewer has the computer actually been used for analyses directed towards problem solving.

Basically, the information resources of a municipality consist of three components: (a) the information itself; (b) the filing system for labelling, organizing, and storing this information; and (c) the systems and methods for utilizing this information. The focus of this report is on the second component, the development of a co-ordinate system for labelling and storing information. However, before embarking upon this task, these three components require further discussion:

1. Information. Most municipal information is the direct by-product of the required work of each Municipal Department. Some of it is the result of on-going duties, such as the issuance of building permits, and is automatically kept up-to-date. Other elements of this information resource are the result of special-purpose studies, such as a traffic flow study, and are only up-dated if the study is repeated and fresh data are gathered for the specific task involved. The information resources of a Department are inevitably a reflection of the perceived importance of the job being done, or the ease with which particular information is made available.

2. Labelling and filing. When a Municipal Department decides that it needs certain information, it usually proceeds to satisfy that need as quickly as possible without reference to other potential uses or users for that information inside or outside the Department. Over time, each Department develops its own records, many of them overlapping with other Departments, and with the information inevitably recorded in such a way that direct collation with or transfer to another Department is not possible. While this array of individualized systems may satisfy Departmental needs, it nevertheless results in

great duplication of effort.

"Getting together" is the obvious solution, but the time honoured systems of the various Departments are defended to the end and hinder common approaches to information recording. For example, the same information about a parcel of land may be labelled and filed by address in one Department, by roll number in another, by legal description in a third, and by owner's name in a fourth. Add on the census tracts, serial numbers, map indices, area codes, chronological ordering, traffic districts, subject files, special purpose codes, welfare areas, and so on. While each of these "filing systems" may be totally adequate for a Department's present internal needs, the computerization of information to save time and effort, or the cross-tabulation of information to assist in management level decision-making, is impossible without the introduction of some common reference system, such as formulated in this report.

3. Using Information. No information or its filing system is of any value if it cannot be put to use. Traditionally, great reliance has been placed on one individual's "feelings" about how things should be done. Without discounting such leadership abilities, today's world requires more decisions about broader matters in less time than our pioneers ever dreamed of. There is still plenty of room for the well-informed decision maker, but a great deal of work has to be done beforehand if his decisions are to be knowledgeable and reliable.

The system for using information depends of course upon the circumstances involved. A computer is no magic brain that is going to solve all the problems, and many Municipalities do not need one. But where growth is rapid, where the information volumes are high, and where quality decisions are needed and expected, then a computer can be of great use. The computer has been readily adapted for accounting and repetitive clerical tasks. The potential for providing factual information for Municipal management purposes -- that is, to improve the quality and the speed of decision-making -- in municipal government has just begun to be applied. While most offices have had an interest in introducing labour-saving, time-saving techniques, there has been reluctance to think in terms of the total processes performed by staff.

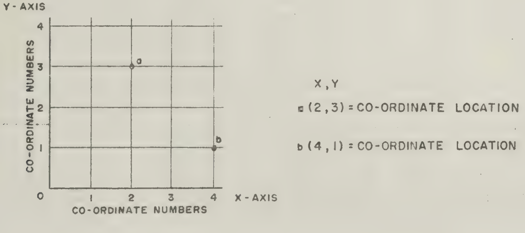
Recent advances in computer technology have greatly expanded the potential for computer use. "Shared time" computer facilities could permit the use of a single large computer by all the Greater Vancouver Municipalities using direct or telephone line connections and individual "terminals" in each Municipal Hall or each Department, depending upon need. Each Municipality would have its own "code number" to give access to its private files. The "shared time" arrangement would carefully shuttle a myriad of requests to give rapid service to each "terminal", which is not unlike a typewriter, and almost as simple to operate. Property enquires, payroll, tax billing, management information and other needs could all be handled quickly and easily.

This report is only a beginning of a comprehensive information systems programme. Such a programme could well be carried out by the Lower Mainland Regional Districts, particularly the Greater Vancouver Regional District in conjunction with its Member Municipalities, other Regional Agencies, and interested Provincial and Federal Departments and Agencies. Improved access to essential information through such things as standardized assessment forms and classification systems, and shared-time centralized computer facilities will all assist in the decision-making process.

CO-ORDINATE SYSTEMS

Any solution to the problem of gathering information and making it available to all the Departments that will want to use it, must provide a common identification system that is acceptable to all. What is needed is a "co-ordinate system" whereby information is referenced to a unit area, such as the individual lot or parcel, with built-in assembly of such units to any desired area of reference, be it a "site", block, square mile, or the entire Municipality. As such, a co-ordinate system is simply a numbering system for identifying location. It takes the form of a simple grid laid over the surface of the land on which point locations are completely and uniquely described by co-ordinate numbers representing the intersection of numbered grid lines, as shown below.

These unique numbers then form the location label to which information can be referenced. Information can then be collected, stored, retrieved and processed easily by any Department by using a common filing system based on the systematic identification of location.



Basically, there are two types of co-ordinate referencing systems in use in North America today. The first of these uses is the street-oriented grid, which identifies individual lots with respect to the street on which they are located. Streets may be numbered on a regular basis, with careful regard for the geographic location of each segment of a given street, or on an irregular basis, with streets numbered more or less consecutively without regard for geographic location. The LMRPB Valley House Numbering System* is an example of the former, while the City of Vancouver Identification System is an example of the latter.

The second type of co-ordinate referencing system uses the uniform grid as its basis, and references point or area locations according to their exact position on the earth's surface without regard for streets or other features. Three types of uniform grids are in use:

(a) Military Grid: a 1,000 metres square grid System used by the Federal Department of Mines and Technical Surveys.

(b) Polyconic Map Projection: used for cadastral surveys by the Surveys and Mapping Branch, Department of Lands, Forests and Water Resources, Victoria, B. C.

(c) Universal Transverse Mercator Map Projection (UTM): The map projection used for the National Topographic System maps, for geocoding the Canada Land Inventory, and for the Dominion Bureau of Statistics Geographically Referenced Data Storage and Retrieval System (GRDSR).*

The uniform grid is perhaps the simplest co-ordinate system, for it can be imposed on any terrain, developed or not, and can describe location to whatever degree of accuracy is required. In the diagram below, reading the horizontal co-ordinate first, the point "a" is described by 7,1; line "b" by 2,4 - 6,7; and area "c" by 3,4 - 5,4 - 4,3 - 5,3 - 5,2 - 2,3 - 3,4. Such a system has the advantage of accuracy, but is unsuitable as a municipal or regional co-ordinate system in that it pays no attention to the street pattern, the pattern to which virtually every municipal activity is tied. For

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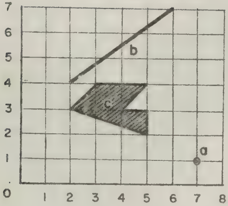
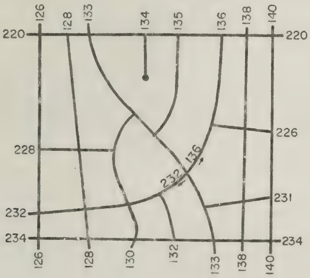
*As subsequently developed in this report, the Valley House Numbering System provides the framework for the Valley Co-ordinate System, and the Dominion Bureau of Statistics "GRDSR System" is adopted as the most appropriate system for the Metropolitan Vancouver area.



example, if "b" were a street, the houses along it might be described as 2.09, 4.13; 2.12, 4.17; 2.18, 4.25; 2.24, 4.32; and so on. While these house locations may be accurate, they convey no indication that they are all located on the same road, and provide little basis for either research work or daily adminstration.

The street-oriented grid is actually a military grid that has been pulled, twisted, and turned to fit the street pattern it attempts to describe.

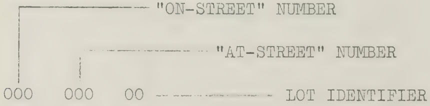


Using such a system, properties are then referenced to the street they are located on (the "on-street") and the nearest intersecting street (the "at street"). Such a system is far more useful than the military grid for municipal and regional co-ordinate system purposes in that it provides a mathematical framework for handling data on the basis of the streets to which most features are related. However, major difficulties are encountered in areas that are just undergoing development, for future roads and intersections are still unknown. It also suffers from the loss of geographic uniformity.

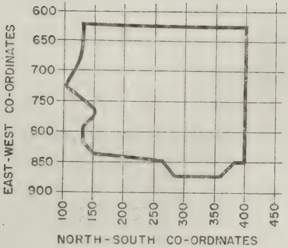
The "500 System": A Street-Oriented Co-ordinate System

An earlier LMRPB draft report on co-ordinates proposed a "500 System", an adaptation of the City of Vancouver Identification System. This system would provide a 10-digit co-ordinate reference system for the entire Lower Mainland. The subsequent LMRPB Interim Report on the Regional Co-ordinate System re-examined this proposal, pointing out advantages and disadvantages, and ultimately questioning its utility for application throughout the Region. Much of this re-examination is repeated in this report to illustrate the general characteristics of an urban area co-ordinate system, and to point out features which must be considered in the selection of the best possible co-ordinate referencing systems for the Lower Mainland.

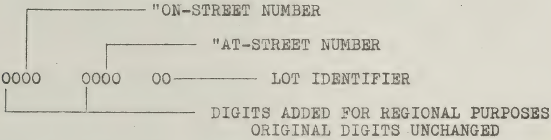
Within each Municipality, the "500 System" used an 8-digit co-ordinate reference number for locating lots. The first three digits identified the "on-street" on which the parcel was located, the second three identified the "at-street", and the last two digits consisted of the last two numbers of the house address.



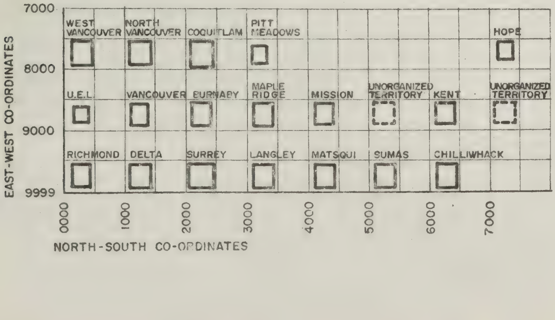
Since an "on-street" could be either a north-south or an east-west street, it was important to distinguish between these, or a location could easily be confused. To provide directional control the numbers 000-499 were used for north-south streets, with 500-999 reserved for east-west streets. This provided 500 digits in each direction, and with more or less consecutive numbering, this would be adequate for each municipality in the region. A map such as the following would result:



For regional purposes, 2 more digits were added to differentiate between the various municipalities or sub-areas of the region. In effect, this added an additional digit to both the "on-street" and "at-street" numbers:



The addition of these numbers could be readily achieved using a simple computer programme whenever data was needed for regional research. Differentiation between north-south and east-west streets would of course still be governed by the original 3 "on-street" and 3 "at-street" digits. The following map shows how this "500 System" would apply to the Lower Mainland as a whole.



Drawbacks to the "500 System".

The L.M.R.P.B. staff spent considerable time testing the application of the "500 System" to the Region, including the preparation of complete maps for the metropolitan area. However, several serious drawbacks emerged:

(1) The use of a consecutive numbering system based upon the present street pattern proved unworkable in partially developed or undeveloped areas. When new streets were created the numbering system would have to be changed, leaving the system in a state of flux unless rigid advance street plans were made.

(2) The use of co-ordinate numbers for an informational role as well as location identifier also relied upon an advance street pattern. As with the Vancouver Identification System, the "500 System" used every digit ending in 0 to specify a major street. Where areas were not subdivided or where areas were not fully developed, this practice proved meaningless or confusing.

(3) The "500 System" had insufficient digits to cover the larger municipalities. In five larger municipalities, the practice of using 500 numbers in each direction would not cover the territory without a loss of flexibility for accommodating future change and development.

(4) The "500 System" distorts geography by stretching and contracting the grid to assign "0-ending" co-ordinates to major streets, or stretching too few digits over too large an area.

(5) When used as a region-wide system, the "500 System" would be continuous across municipal boundaries. The addition of two extra digits complicated to co-ordinate number and produced a fragmented pattern, as shown on page 9. . In the event of the use of the co-ordinate system for simulation of growth, transportation or land use, etc., complicated computer programmes would be required to convert sub-area systems into a continuous regional system, thereby creating another co-ordinate system, and even then the fragments would not fit together adequately.

Clearly, these problems do not apply equally to all municipalities. In some, where the first cycle of development has occurred and road systems are relatively static, the problems are fewer. But where development is still active, the need to overcome the drawbacks of the "500 System" is readily apparent.

An Ideal Co-ordinate System

Ideally, to overcome the drawbacks of the "500 System", a modified system should incorporate the following features:

(1) For both undeveloped and developing areas, it should be an "on-street, at-street" system, capable of having the "at-street" co-ordinates established on the basis of actual geographic location. Then the "at-street" co-ordinate would not change with the creation of each new intervening intersection.

(2) It should assign co-ordinate numbers to streets according to location, and not give special co-ordinate numbers to major roads.

(3) It should have enough co-ordinate numbers to cover each municipality without distorting geography, to retain differentiation between north-south and east-west streets, to allow for future development, to fit into a continuous regional system, and to still retain a minimum number of digits.

(4) It should be geographically uniform and numerically continuous across the region to assure suitability for simulated development or growth-model purposes.

(5) It should be capable of application throughout the Mainland, including the four Regional Districts.

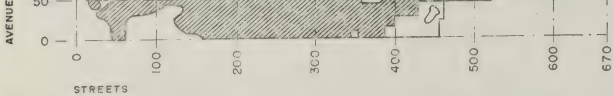
Perhaps the ideal being sought would be a compromise between the uniform grid and street-oriented grid, with just the right blend of each. The uniformity of the former and the street-oriented features of the latter could be combined to overcome the problems of both. Since the basic unit involved is the legal lot, and since every "lot" is located on a street, the only problem that remains is to assign an enduring "at-street" location reference. Built-up areas present no problem because the subdivision pattern receives only minor adjustments if any, but in undeveloped or developing areas, the "at-street" location would best be assigned using a uniform grid, so that lot references would remain constant regardless of the street and intersection pattern that emerges.

These problems were encountered earlier in the Lower Mainland when in 1952 the Valley House Numbering System was designed for the Region. This House Numbering System clearly deserves consideration as the basis for a co-ordinate system.

THE VALLEY CO-ORDINATE SYSTEM

The Valley House Numbering System

The Valley House Numbering System was developed by the LMRPB in the early 1950's, and has since been implemented in the areas shown on the map below. This street and address numbering system uses a uniform grid in which streets and parcel addresses are assigned according to their actual geographic location within this grid. Using 8 grid lines per mile, an east-west "Avenue" grid runs from "0 Avenue" at the Boundary to about "224 Avenue" along the northern limits of the Region. Likewise, a north-south "Street" grid runs from "0 Street" at the western boundary of Richmond* to about "670 Street" immediately east of Hope.† Each of these grid lines or "block lines" marks off a "100 block" within which 100 five-digit address numbers are available for assignment on the basis of location.



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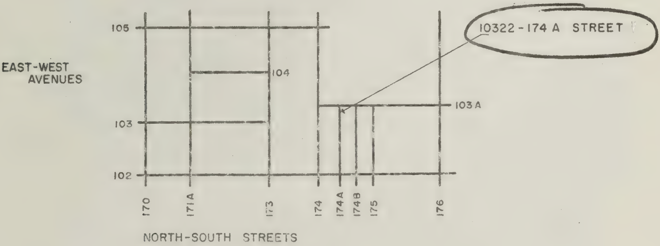
*The western boundary did not take in West Vancouver and the University Endowment Lands as these areas and the rest of the Metro area already had their own well-established address systems.

†Enough numbers are available to extend this street and address numbering system to cover those portions of the Greater Vancouver, Dewdney-Alouette and Fraser-Cheam Regional Districts lying outside the LMRPB planning area.

The major advantage of the Valley House Numbering System over the more typical irregular street and address systems is the capability of a Municipality to assign address before ultimate subdivision occurs. This advantage was felt to far outweigh the lack of correspondence between "100 blocks" and physical blocks where the street pattern may not conform to the numbering system grid lines. To obtain an address number, the first three digits* of the address are taken from the most southerly or westerly intersecting grid line (depending upon whether the property is on a north-south street or an east-west avenue), and two more digits are used to locate the parcel within the "100 block". Some municipalities also use the grid numbers instead of names to identify roads. In these cases, where the street pattern does not conform to numbering grid, streets are assigned letters. A resulting address incorporating all the above-mentioned aspects of the Valley House Numbering System might be 10322-174A Street, indicating a location on the east side of 174A Street near where 103 Avenue (from the first three digits of the house number) would fall, whether or not that avenue actually exists.



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*Three digits are reserved for street and avenue numbers, although they may not all be used. For example a house referenced to 8th Avenue would require only one digit.

Examining the Valley House Numbering System in relation to the features of an ideal co-ordinate system discussed in the previous section of this report, several distinct advantages became apparent.

1. It is geographically uniform and numerically continuous across the region.
2. It assigns a position on a street with reference to a uniform grid rather than to the nearest existing intersection, thus providing an address that does not change as development progresses.
3. It can be extended easily to cover an area 125 miles by 125 miles, more than covering the four Lower Mainland Regional Districts.
4. It is already in wide use throughout the Valley,* and would not require the creation of another arbitrary grid system.

On the strength of these advantages, the Valley House Numbering System was adopted as the framework for the Valley Co-ordinate System.

The Valley Co-ordinate System

The Valley Co-ordinate System was derived from the Valley House Numbering System by taking the street numbering grid and using it as a co-ordinate grid, supplemented by actual house numbers to give a complete co-ordinate reference. This co-ordinate system can be used manually or with automated data processing equipment, making it possible for even the smallest municipalities to adopt the system for manual use at present with a simple transition to automated equipment, perhaps on a shared basis with other municipalities, at a later date. A few simple conventions were adopted to facilitate the use of the Address System as a basis for the Co-ordinate System.†

1. Deriving Co-ordinate Numbers. The Valley System takes the Valley House Numbering System's 1/8 mile square 'block line' co-ordinate grid and numbers as the basis for co-ordinate numbers. Since many streets fall between the 1/8 mile grid lines, an additional digit is required to

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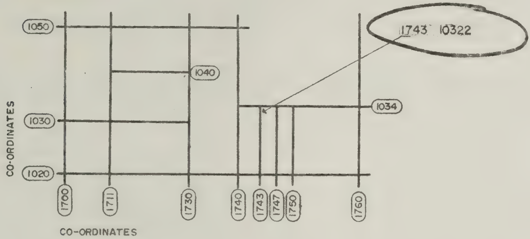
*In all municipalities except Chilliwack City, Harrison Hot Springs and Hope. Kent has a somewhat unique system in that while it uses the same grid, it has renumbered the grid to commence at "0" on both the west and south municipal boundaries.

†For greater detail, see The Valley Co-ordinate and House Numbering System, a manual of procedures for implementing the Valley Co-ordinate System.

locate these streets. In the diagram below, 174 Avenue becomes 1740 as a co-ordinate number, and 174A Avenue becomes 1743. Each such "A" road would have to be considered on the basis of its position in the grid. This



yields 80 co-ordinate numbers per mile, giving more than enough numbers for even the most intricate urban road patterns.

2. Directional Control. The Valley House Numbering System does not differentiate between north-south "streets" and east-west "avenues" on a numerical basis, and the "avenue" co-ordinate 1740 could become confused with the "street" co-ordinate 1740. For municipal work this problem arises only in Delta, Surrey and Kent, so it is of no consequence to the other municipalities. The simplest solution is to add 1000 or 2000 to all the north-south or east-west co-ordinates in these three areas so that no confusion will result. Specifically, adding 1000 to the original north-south co-ordinate numbers in Surrey, and 2000 in Delta and Kent, overcomes this difficulty. When data are being assembled for intermunicipal or regional purposes, similar difficulties arise between municipal areas, and a "3000 addition" is necessary. Such an addition, however, could be carried out automatically using computer techniques, and would not be a problem.

3. Lot Identification. Property references for the Valley Co-ordinate System are derived by supplementing the co-ordinate number of the street on which the property is located with the full house number as established by the

Valley House Numbering System. This gives a 9-digit co-ordinate reference:

Valley house number

0000 00000

Co-ordinate number of "on-street"

For example, the address 22430-48 Avenue would become 0480 22430 as a co-ordinate reference, and the address 4032-224 Street would become 2240 04032. The diagram in item #1 above also illustrates this co-ordinate referencing.

In Surrey, Delta and Kent where 1000 or 2000 additions are made to the north-south co-ordinates to distinguish between north-south streets and east-west avenues with similar numbers, these additions are made only to the on-street co-ordinate numbers, and not to the house address (which contains an at-street reference). Likewise, the "3000 addition" for intermunicipal and regional work applies only to the north-south on-street co-ordinate number. This enables retention of the actual house number for all data handling purposes. However, if lot-by-lot information is used for work to be done at the co-ordinate level, the computer can be easily programmed to "read" the full co-ordinate reference and convert it to fit the co-ordinate number grid. Thus, 1743 10322 would become 1743 4032 (drop the last digit of the house number and add 3000), and 4743 10324 would become 4743 1032.

4. Areas not using the Valley House Numbering System. Hope, Harrison Hot Springs, and Chilliwack City are not presently on the Valley House Numbering System, nor are some larger areas of sparsely developed Unorganized Territory. The "Valley Co-ordinate System" can easily be applied in Hope, Harrison and Chilliwack even though the system would not be related to the local address systems in these areas. And as for the Unorganized Territory, it is likely that the Valley House Numbering System would be extended to these areas as and where development occurs. In any case, the "Valley System" could be extended to these areas as and where development occurs.

Thus, it is apparent that the "Valley Co-ordinate System" can be readily used for the Valley area. It is a continuous and uniform system that is unaffected by any changes in development or municipal boundaries. The fact that it is tied to the Valley House Numbering System already in effect in most areas simplifies considerably its use by clerical staff in the municipal halls. The only problem that remains is to tie this "Valley Co-ordinate System" to some system or systems in the Metro area.

METRO SYSTEM

Reviewing the situation to this point, we have on the one hand the "500 System" in effect in the City of Vancouver, and on the other hand a "Valley System" outlined for the Valley area including Surrey, Delta, and White Rock. The "Valley System" was designed to overcome several drawbacks that arose with the "500 System", especially when it was applied in areas where development was far from complete, and in areas where numbers were insufficient to cover larger municipalities and provide directional control.

It was originally proposed (in the Interim Report) that the Valley Co-ordinate System be extended westward to cover the "Metro" area. However, LMRPB staff discussions with the Dominion Bureau of Statistics and others, and the prospect of DBS developing a total information system for large urban centres, led to a re-examination of this earlier proposal. The DBS computer-based "Geographically Referenced Data Storage and Retrieval System" (GRDSR) is now recommended for use in Greater Vancouver for all location-based data handling. Delta, Surrey, and White Rock would logically use the Valley Co-ordinate System, but could be readily converted to the GRDSR System at a later date. Even though the system requires a computer, it is felt that its many advantages far outweigh its disadvantages.

The Dominion Bureau of Statistics GRDSR System

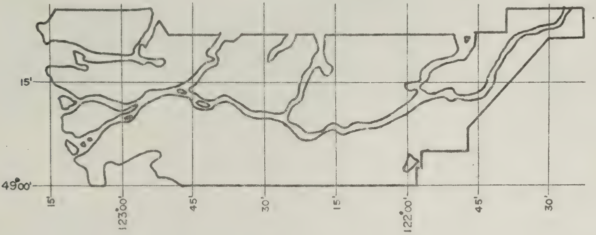
The GRDSR System is based on a semi-automated geocoding (location referencing) process. It also involves other aspects of a total urban area information system including a computer storage and retrieval system which provides maximum efficiency in storing, retrieving and manipulating (cross tabulation, statistical analyses, etc.) all DBS statistical information that can be related to a geographic location. Its first major use will be for the 1971 Census, which is to be carried out in the inner metro areas of Canada by mail rather than by door-to-door enumeration. House addresses will be used for assigning returned forms to their proper location. At last word, it was intended that Vancouver, Burnaby, and New Westminster would be covered by this system for the 1971 Census, but that other municipalities could be added, depending upon time and resources available and the extent of local interest and assistance. Work on Vancouver has already been undertaken through the Engineering Department.

The development of the GRDSR System was predicated on much the same needs that stimulated the LMRPB to pursue the unification of information systems in the Lower Mainland. The DBS has experienced difficulty in meeting all the needs of statistics users throughout Canada, particularly those needs requiring information for areas which did not coincide with Census Tracts or Enumeration Areas. There is a wide and growing need for a usable data base for public and private decisions, particularly in Canada's urban areas. Already rural area research and management has been facilitated by the implementation of a geo-coding reference system for the Canada Land Inventory and related ARDA undertakings. The DBS system has been developed in response to these growing demands, to dissatisfaction with present very long waiting periods for even published Census data, and to the difficulty of using data at the aggregated Census Tract level. The intent has been to provide a system capable of satisfying Census needs, capable of providing a user-oriented data service with tabulation and correlation for a nominal sum with 2-3 week maximum waiting periods, and capable of adaptation for use as a municipal or regional information system. Follow-up research by the Greater Vancouver Regional District in particular should explore the development of the GRDSR System for municipal office data processing operations directed towards the implementation of a total urban information system for the Lower Mainland.

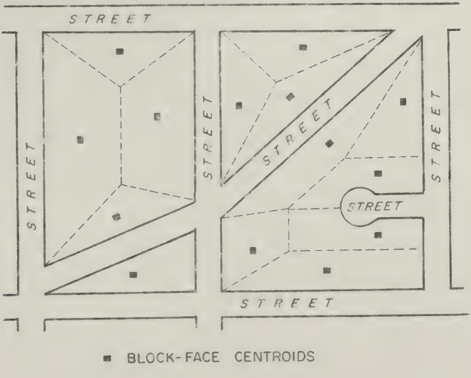
How the GRDSR System Works

Essentially, the GRDSR System uses house addresses as the means of assigning and retrieving information using computer storage. House addresses are assigned to their geographic location using geographic co-ordinates, but the actual co-ordinates are never used by personnel. Instead house addresses alone, or maps with areas of interest outlined, are used to "communicate" with the computer and automatically locate the information.

Using the Universal Transverse Mercator (UTM) map projection and latitude-longitude references, the GRDSR System permits unique locational references for all of Canada. The addition of extra digits provides whatever accuracy is required, enabling the system to be used for legal survey work. Thirteen digits enables accuracy to within 1 metre, but if the system were used on a local basis, some initial digits could be dropped. The following map illustrates the major latitude-longitude references for the Lower Mainland that would be used in the system.



Information is referenced to the individual lot on a "block-face" basis. A block-face consists of all the lots fronting on one side of a street between intersecting streets, or over specified address ranges. Odd or even house numbers are used to allocate addresses to one side or the other on the basis of local conventions. Where different major land uses break up a block, or if there are no streets dividing "100 blocks", address ranges can be used to specify any desired length of block-face. Each "block-face" in turn is given a co-ordinate number at its centroid, and this number would serve as the key to all the data for that block-face. The diagram below illustrates how centroids would be assigned.



Several steps are necessary to establish the co-ordinates for the block-face centroids and to develop a system for assigning addresses to these co-ordinates. First, using an accurate 1":1000' or 1":800' map showing the address ranges for each block-face, the points or "nodes" where each street started, ended, intersected with another street, or changed direction would be consecutively numbered. Second, a "digitizer" connected to a computer would be used to assign computer-stored co-ordinate numbers to the "nodes", and thence to the block-face centroids. Third, a complete house address register for every property in the metro area, including vacant lots, would be used to develop a conversion programme for the computer for assigning individual addresses to the appropriate centroid. The result is a highly sophisticated referencing system capable of handling the full range of locational data needs and analysis.

Implementation of the GRDSR System

The Dominion Bureau of Statistics is interested in working through some regional agency to implement the GRDSR System in Greater Vancouver. DBS has maintained some contact with the LMRPB staff to date, and this relationship should be continued with the Greater Vancouver Regional District. The prime interest is to get as many Canadian metropolitan centres as possible using the System for the 1971 Census. In Greater Vancouver, initial interest focuses on Vancouver, Burnaby and perhaps New Westminster, but if local interest and willingness to actively participate is in evidence, additional areas could perhaps be included.

The entire programme depends upon regional and local co-operation and direct assistance. Accurate up-to-date maps showing block-face address limits, a complete accurate address register for every household, and the preparation of complete code sheets ready for key punching would be required, as would periodic updating. For an urban area of one million people it would take DBS about 2½ clerk-years to prepare the address register, the address range maps, and the street "nodes", and another 50 computer hours to digitize these "nodes" and the block-face "centroids". In exchange, DBS would be in a position to provide 1971 Census data tabulations for whatever areas were specified by the Municipality concerned, and would offer access to address conversion and other programmes essential in building a basic Municipal information system. Such programmes would be designed to operate on medium-scale computers, and would enable the Municipality to geo-code, store, and retrieve local information for assessment, planning, traffic, land use, zoning, education, or health and welfare purposes.

In relation to Census data, information would be available for whatever areas the user wished to define, not just Census Tracts or Enumeration Areas. Municipalities using the system would also be able to have their own data cross-referenced with Census data, provided no problems of data disclosure would result. Users would specify their areas of interest on a DBS supplied map, and the computer would automatically pull the desired information using a polygon described by co-ordinate numbers. A person with no previous computer programming knowledge could become quickly acquainted with request forms which could be fed directly into the computer, pending the development of a system to convert form initiated requests into machine language. Failing this, and for more complex data retrieval and manipulation, pre-programmed routines would be developed for the more frequent relatively complex data requirements of municipal and regional users.

CONCLUSIONS

The key conclusions and/or recommendations that have emerged in the course of this study of Co-ordinate Systems for the Lower Mainland can perhaps be briefly restated at this point.

1. Valley Co-ordinate System. For the "Valley" area and the metro municipalities of Delta, Surrey and White Rock, the Valley Co-ordinate System emerges as a simple and direct system for organizing municipal information, extensive or otherwise, into an efficient, accessible form. Its capacity for both manual and computer use with co-ordinate referencing will be particularly important as automated data processing equipment becomes increasingly available.

2. The Metro (GRDSR) System. While this system is more complex than the Valley Co-ordinate System, and while it requires automated data processing equipment for its use, its scope in facilitating analyses and in drawing on data collected by other agencies is particularly important. Like the Valley System, it is simple and direct, also using the house address as the key to information. It is also capable of easy extension into Delta, Surrey and White Rock, and the Valley System can be readily converted to the GRDSR System as and when development and the availability of computer equipment warrants.

3. Implementation. The Lower Mainland Regional Districts should logically assume responsibility for encouraging the further exploration and implementation of the Valley and GRDSR Co-ordinate Systems. Any further investment in research and development of the systems would logically be shared by the benefiting municipalities, and the

importance of all municipalities undertaking the same kind of system cannot be under-estimated.

4. Shared Time Facilities. The development of shared time computer facilities with telephone connected terminal facilities enables almost unlimited data storage and facility utilization. Such facilities could well provide centralized, but private, data processing for all the municipalities in a region. The Lower Mainland Regional Districts, particularly Greater Vancouver, should explore the potential of such facilities with a view to improving Municipal information systems and reducing total computer costs.

While these four points may at first appear to be unrealistic, the expanding demands for accurate information and the increasing sophistication of local and regional government will require such solutions sooner or later. There is no time like the present for commencing this task.